NASA SBIR/STTR Technologies

H5.02-9227 - Metallic Joining to Advanced Ceramic Composites

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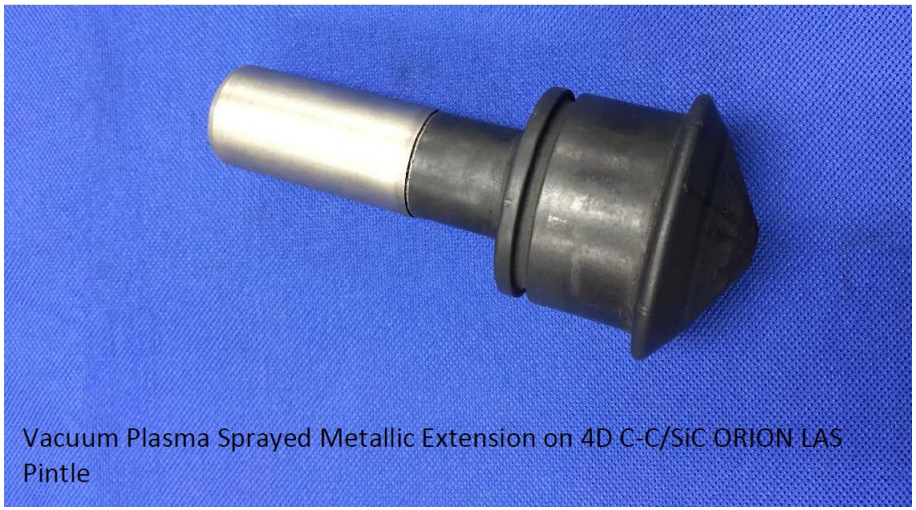
Identification and Significance of Innovation

Advanced ceramic composites have joining challenges that need to be met for success in demanding hypersonic and space propulsion applications. New assembly and joining methods to reduce fabrication challenges are needed so that the ceramic composite specific strengths and high temperature capabilities are not diminished. Three opportunities to join advanced ceramic composites to metallic structures are proposed that will reduce part count, joints, and increase safety for the SLS/Orion Launch Abort System (LAS) Attitude Control Motors (ACM).



Vacuum Plasma Sprayed Metallic Extension on 4D C-C/SiC ORION LAS Pintle

Estimated TRL at beginning and end of contract: (Begin: 4 End: 6)

Technical Objectives and Work Plan

The overall objective of Phase II is to develop, qualify and test carbon composite pintles joined with Inconel 625. The specific objectives are:

- Optimize composite/metal interface geometry
- Enhance materials properties database
- Optimize spray formed deposition and develop near-net-shape deposition techniques to produce assemblies of advanced high temperature materials such as C/C-SiC composites, and super alloys for hot-gas propulsion applications.
- Evaluate machining options
- Investigate alternative ceramic composites and components
- Fabricate test pintles
- Hot fire test joined pintle(s) in HT 11 test
- Evaluate ACM Quill shaft fabrication and joining to pintle
- Join ACM Coupler and Split Ring into Pintle Guide

NASA Applications

Improving the joining of advanced materials including advanced ceramic composites to heritage metallic hardware is needed for future launch vehicles. The proposed work promises to improve the capability and reduce the risk of current mechanical joining methods. A partial list of existing and future NASA programs to benefit from this enhanced capability include the ACM motors of Orion MPCV's Launch Abort System; human Lunar ascent/decent; LAS systems for commercial crew systems (SpaceX, Boeing).

Non-NASA Applications

Applications are upper stage engines requiring joining of CMC nozzles for satellite launch and ISS resupply (e.g. SpaceX's Merlin Vacuum); and upper stage nozzle extensions, nosetips, leading edges and control surfaces for hypersonic vehicles; turbine engine components, exit cones and control vanes for tactical missiles, and pintles for LAS systems for commercial space.

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